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SATURDAY, NOVEMBER 19, 1881.

EDISON'S METHOD OF PRESERVING ORGANIC SUBSTANCES.

In a recent number of this JOURNAL,* we published a report by Mr. Otto Hehner, an official analyst of London, England, who had endeavored to trace the cause of the gastric disturbances, which were traceable in persons who had consumed preserved articles of food put up in tin cases. This poisoning had been attributed by some to traces of lead dissolved from the solder with which the tins were closed, but Mr. Hehner, although admitting the occasional presence of lead in such cases, found on a careful analysis of both vegetable and animal foods thus prepared in tin cases, that the trouble was caused by tin.

With one exception he found that the whole of the samples contained more or less tin, many to such an extent that abundant reactions could be obtained from two or three grammes of the vegetable substances; whilst of the animal foods one of the soups contained thirty-five milligrammes, one of the condensed milks eight milligrammes, and oysters forty-five milligrammes of tin to the pound.

In reply to the question whether tin when thus taken up in the system was injurious or not, he states that as forensic literature does not furnish a positive and satisfactory reply, he endeavored to settle the question by making a few experiments.

These experiments which will be found on page 507 of this JOURNAL, produced results which caused him to draw the following conclusions: "it plainly follows that while stannic compounds are not injurious in the doses given, tin in the stannous condition, is a virulent irritant poison."

These facts induced Mr. Hehner to demand some other and improved method of packing preserved food other than by the use of tin cases.

A remedy appears to hand at a most opportune moment. In the Patent office reports for October 18, last, we find that Mr. Edison has invented a method of preserving articles of food in glass vessels from which the air has been exhausted and a high vacuum produced. The glass vessel is then hermetically closed by sealing off the channel to the air pump, the envelope produced being essentially a homogenous piece of glass. This invention appears to meet the difficulty experienced in the use of tin cans and promises great results in offering a method of preserving fruits and other organic substances in which their original purity and freshness is maintained to a great degree, and the introduction of mineral poisons rendered an impossibility. The specification, as usual, is very brief and we hope to present our readers with a more detailed description of this interesting invention, on a future occasion.

ALCOHOLIC TRANCE.

At a meeting of the New York Medico-Legal Society, held at the Hall of the Academy of Medicine, November 2, Dr. Crothers read a paper on "Alcoholic Trance." The main point of the paper consisted in an attempt to establish the existence of a trance-like condition in inebriates. In this condition they were supposed to commit all sorts of ridiculous, or injurious, or even criminal actions, without a subsequent recollection of what they had done. Dr. Crothers related cases, the like of certain of which no other physician has yet seen or reported, and the like of which it may be quite safe to say no other physician is likely to record in the future. One was that of an engineer who ran a Mississippi steamer an entire trip without knowing it; another of a gentleman who regularly woke out of his "trance" at a railroad station, and was compelled to ask his fellow passengers where he was; a third, a house-painter, who would regularly climb to the top of a house, paint a whole story correctly, come down and "wake up." Other cases were still more complicated, and evidently called into action the *risorius* muscles of the Doctor's audience. Among the less remarkable instances was one of a hack-driver who became a confirmed drunkard, and several times went to States Prison, finally dying there, after being convicted of stealing horses; and of a solicitor, who had fits of jealousy and suspicion concerning his wife, and made a number of wills in a trance-like state.

Dr. Spitzka stated that he would like to ask the reader of the paper two questions. As far as he could gather, the reports were all obtained from third parties. His first question was whether Dr. Crothers had ever himself seen patients in this alcoholic "trance?"

Dr. Crothers replied that he had.

Dr. Spitzka reiterated that in that case the attendant phenomena had not been described by the Doctor in a convincing manner. His second question was, whether the hack-driver referred to had exhibited any inequality or anomaly of the pupils, the facial folds or tremor of the tongue and hands?

Dr. Crothers replied that he had manifested none of these symptoms, after some hesitation.

Dr. Beard took the floor. His remarks were not of such a nature as to permit the reporter to follow him, but

*"SCIENCE," No. 69, October 22, 1881.

he read an extract from the *Journal of Mental Science*, which he claimed showed the awakening interest manifested by Europeans in "unconscious states." The Doctor then wandering off to the fall of a Swiss mountain and to Astronomy, was called to order, and subsided.

Dr. Spitzka, without desiring to introduce personalities into the discussion, remarked that it was a pity the preceding speaker had not turned back a few pages in the *Journal of Mental Science* and read the extract relating to the collapse of Dr. Beard's demonstration in England, and how Dr. Beard had failed to come forward with a paper he had announced before a scientific body. As to the paper read that evening, he regretted to say that instead of science being behind in its views on the question of alcoholism, it was the paper which was far from being up to the science of the day. He would call the attention of the reader to Magnan's work, in which he would find such of his cases as had the strongest semblance to reality, carefully described under the heads of alcoholic stupor and alcoholic epilepsy. As to the hack-driver's case, that was an evident example of a well-established and well-known form of disease, namely—alcoholic paralytic dementia. He was surprised to find such a common manifestation of alcoholism as tremor reported absent by Dr. Crothers. He was still further surprised to find such ordinary everyday and characteristic symptoms of chronic alcoholism as delusions of marital infidelity, morbid suspicion, inconsistencies of behavior, stupor and amnesia erected into trance-like states. Nowhere in the paper did the author give any evidence that he made that distinction between Dipso-mania, Chronic Alcoholism and Acute Alcoholic Delirium, which was the A B C of our knowledge of the subject. The speaker concluded by regretting that the first time in years that so important a matter was brought before the Society, it was brought forward in so imperfect a form, and coupled with a term "trance," which in the past history of the Society had certainly acquired no good odor.

Dr. Girdner endorsed the preceding speaker's remarks, and gave an analysis of the ordinary effects of alcohol on the mind, which he referred to dynamic interferences. He concluded by objecting to the acceptance of such views as Dr. Crothers advanced until they could be better substantiated, as their acceptance would involve some remarkable medico-legal consequences. He did not believe that alcoholism, aside from its effect in producing chronic insanity, should constitute an excuse for crime. He thought that a crime committed in a drunken excess should be punished like any other crime, because the person, by his own agency, put himself in a proper condition to commit such crime.

Mr. Eller, of the New York Bar, stated that the view last announced by the preceding speaker was not a sound one in law; it was certainly not the one entertained by lawyers. He alluded to the great injustice done by police justices in sending persons to the workhouse on the complaint of any two (possibly) conspiring persons, that such person was a "habitual drunkard." He thought that term required definition.

Dr. Crothers, in closing the discussion, among other remarks of a general character, stated that our knowledge of alcoholism was not at all perfect, and that his views were an addition to science, notwithstanding what had been alleged that evening.

M. PICKET has examined seven varieties of steel (chiefly from a Sheffield and a Vienna house) with regard to magnetic power *Arch. des Sciences*, August 15). This power he finds to depend on the presence of carbon in the iron, and the aggregation of these substances. One of the two steels giving the best results had $\frac{7}{8}$ th per cent of carbon. Samples with $1\frac{1}{2}$ and $1\frac{3}{8}$ th per cent were inferior.

NEW YORK ACADEMY OF SCIENCES.

October 24, 1881.

SECTION OF PHYSICS.

Vice-president, Dr. B. N. Martin, in the Chair.

Thirty-one persons present.

Mr. W. Le Conte Stevens read a paper, of which the following is an abstract.

WHEATSTONE AND BREWSTER'S THEORY OF BINOCULAR PERSPECTIVE.

For some time after the publication of Sir Charles Wheatstone's essay ⁽¹⁾ in 1838, on the Physiology of Vision, this subject was studied with much zeal by Sir David Brewster, whose name is permanently associated with the lenticular stereoscope, an instrument now familiar in every household. Although the theories advanced by these two physicists to account for the illusion of binocular relief have since been shown insufficient, their mode of accounting for the estimate of distance as perceived in the stereoscope has been quite generally accepted. In 1844, Brewster published an essay ⁽²⁾ "On the Knowledge of Distance given by Binocular Vision," in which he elaborated and abundantly illustrated the idea that the apparent distance of an object is determined by the intersection of visual lines. The stereoscope had already been explained as an instrument by which rays of light from two slightly dissimilar pictures were made to enter the eyes, as if coming from a single object into which they are combined in front, and on each point of which the visual lines could be made to meet. Thus, in Fig. 1

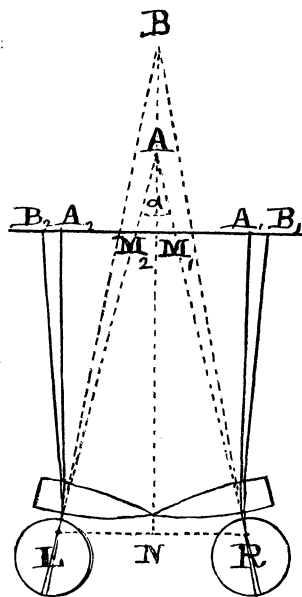


FIG. 1.

if rays from the conjugate foreground points, A_1 and A_2 , be deviated by the semi-lenses, they appear to have come from A . In like manner, the background appears at B . If i = interocular distance RL , and a = optic angle, then for the distance of A we have

$$D = \frac{1}{2} i \cot \frac{1}{2} a$$

From this formula it is obvious that D ceases to have any positive finite value when the visual lines cease to converge.

If the semi-lenses be taken away, and A_1 and A_2 be

⁽¹⁾ Phil. Transactions, 1838, Part II.
Reprinted in Phil. Magazine, s. 4, vol., III., April, 1852.

⁽²⁾ Edinburgh Transactions, vol. XV., Part III., p. 360.

removed to M_1 and M_2 respectively, while the convergence of visual lines remains unchanged, the images still appear at A and B. Wheatstone seems to have been the first to show experimentally that the illusion of apparent solidity can be obtained in this manner from a pair of projections representing the same object from slightly different points of view. If the eyes be properly trained, the visual lines may be directed to points whose distance is greater or less than that of the objects regarded at the same moment, and Brewster described many striking illusions thus obtained without the aid of the stereoscope. The principle applied by him, as described in the paper to which reference has been made, may be briefly given, and his results can be easily tested by anyone who is accustomed to analyzing his own visual sensations. Upon a uniform horizontal surface (Fig. 2) let two lines, A C and B C, be drawn, forming a small angle, β , with its vertex toward the observer. Let the eyes, R and L, be placed above this. If they be directed to the point, C, this appears in its true position. If the right eye be directed to B and the left to A, the axes meet at P; this point Brewster calls the binocular centre; and since the retinal images of B and A correspond, the visual effect is that of the union of these two external points at the binocular centre. Sweeping the glance toward C, the two lines appear united in the air, and P C is the apparent position of the combination, intermediate in direction between two monocular images, which may be disregarded or hidden from view with screens. If the convergence of visual lines be now diminished, the binocular image is lost until the right eye becomes directed to A and the left to B. The two points appear united at P', and the line P' C now appears in the air on the further side of the surface. If the convergence be increased till P is again the binocular centre, and the face be lowered and withdrawn till the eyes are at R" and L", then C P" becomes the position of the variable external image. And if lowered until R" L" coincides with the surface, C P" vanishes at the moment of becoming coincident with the prolongation of G C, the median of the triangle A C B.

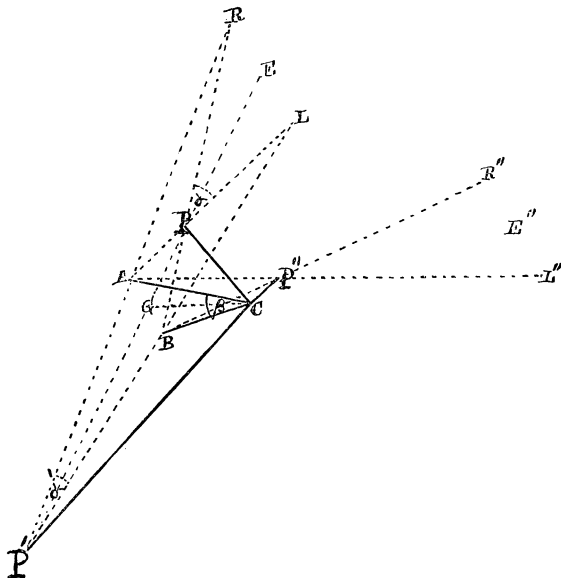


FIG. 2.

Brewster's formula for determining the distance of the binocular centre from G is easily deduced and applied.

Let i = interocular distance, R L.

" a = interval between the corresponding points, A and B.

Let b = distance, G E, between card and observer.

" x = distance G P, or G P', which is positive when measured toward the observer, negative in the direction opposite. Then, observing the usual rule of signs, we have, by Geometry,

$$x = \pm \frac{a b}{i \pm a}$$

Applying this formula, Brewster constructed a table of distances for the binocular centre. For negative values it is seen that x becomes infinite when the visual lines become parallel; and, if they be slightly divergent, the binocular centre is far in the rear of the observer. Either of these conditions would make binocular vision impossible if the theory be correct. In testing the experiment with trained eyes, it is found quite possible to secure binocular fusion of the images of A and B when the interval between these points equals or slightly exceeds the interocular distance. It is also found that fusion of the images of the whole line at any given instant is impossible, especially when the angle β is large, or the lines are viewed very obliquely, as from R" and L". If the images of A and B fall on corresponding retinal points, the resulting sensation is binocular fusion, whether the visual lines be convergent, parallel or divergent; and the images of any two points nearer or farther apart cannot fall on corresponding retinal points at the same moment with those of A and B, though small differences are easily neglected. Whatever may be the importance therefore of optic convergence, as a factor ordinarily in determining the binocular judgment of distance, it has no such exclusive and measurable value as that attributed in Brewster's experiments; and the apparent distance of objects viewed through the stereoscope is obviously not determined by intersection of visual lines, if conditions are such as to render these parallel or divergent. The visual effects of optic divergence can be more conveniently studied by using stereographs than by the method already described, and a modification of Wheatstone's reflecting stereoscope affords the best means of measuring variations of the optic angle. As the lenticular stereoscope, however, is now almost universally employed, it is important that this instrument, as found in the market, be examined first.

By diminishing the natural convergence of visual lines, the stereoscopic effect of binocular relief can be quite easily obtained, while gazing upon a stereograph, without any instrument, when the interval between corresponding points of the two pictures does not exceed that between the observer's optic centres. This distance does not often differ very much from 64 mm., which may be taken as an average value. In Fig. 3 the distance between the two central dots is 50 mm. If the reader will fix his gaze upon a point ten feet off, just visible below the edge of the page, and then suddenly raise the visual lines to the figure without changing their convergence, he will see three circles instead of two; the central one moreover will appear as the base of a cone whose vertex is pointed toward him, but capped with a small circle. A little attention then will reveal the fact that when the dots are seen distinctly and singly, the small circle is double and slightly indistinct, and *vice versa*.

On stereographs, however, the interval between corresponding points is always greater than 50 mm. As the result of measurement made upon the foreground intervals of 166 cards, European and American, taken at random, the mean value I have found to be 72.9 mm., the maximum being 95 mm. If binocular combination is secured without the stereoscope, therefore, optic divergence is nearly always necessary. To ascertain the extent to which this is counteracted by the semi-lenses of our best stereoscopes, 30 pairs of these were kindly loaned me by Mr. H. T. Anthony, of New York. With very slight variation, their focal length was found to be 18.3 cm., and their deviating power not sufficient to prevent the neces-

sity of optic divergence, when the pictures are binocularly regarded through them, if the stereographic interval exceed 80 mm. As this limit is not unfrequently exceeded, optic divergence is often practiced unconsciously in using the stereoscope. Every oculist is familiar with the mode of using prisms to test the power of the muscles of the eyeballs, for both convergence and divergence of visual lines, and knows that 4° or 5° of divergence is not uncommon. Helmholtz (3) refers to the use of stereographs for the same purpose.

But familiar as is the production of optic divergence by artificial means, little or nothing seems to have been written in regard to the modification which the possibility of it imposes upon the theory of binocular perspective held by both Wheatstone and Brewster, accepted by most writers on vision since their time, and abundantly reproduced in our text books on Physics.* Of these I have not been able to find one that gives any account of the stereoscope except on the hypothesis that the visual lines are made to converge by the use of this instrument. On the uncertainty attached to the judgment of absolute distance from convergence of visual lines alone, Helmholtz (4) has written more fully than any one else. It is unfortunate that no English translation of his masterly work on *Physiological Optics* has ever been published. Although he gives no analysis of the visual phenomena produced in binocular fusion by optic divergence, his discussion of the judgment of distance would certainly tend to cast some doubt upon the explanation of vision through the stereoscope, as found in our text-books. And yet Helmholtz himself employs Brewster's theory in his mathematical discussion (5) of stereoscopic projection. This discussion, on the data assumed, is a model of elegance; but it contains no provision for divergence of visual lines. It is strictly applicable to the conditions involved in taking photographs with the binocular camera, and to the projection of images viewed in the stereoscope when the convergence of visual lines is identical with that of the camera axes, but not otherwise. Instead of human eyes we may assume a pair of camera lenses, an interocular distance apart, and a pair of sensitized plates behind them. Helmholtz's formulas enable us to determine the stereoscopic displacements in the images projected. If proofs from the negatives thus obtained be inverted and placed in front of a pair of eyes in such manner that the visual lines passing through corresponding photograph points shall bear to each other the exact relation that existed between the secondary camera axes that terminated in them, these two points will appear as one, and nearly at the distance of the real point in space to which the camera axes were converged. The effect is much the same as if the eyes, with normal convergence of visual lines, had been substituted for the cameras. But if the proofs be too near together or too far apart, increase of convergence makes the whole picture seem nearer, while divergence makes it farther. The relation between the different parts having been fixed at the time the picture was taken, increased convergence makes the distance from background to foreground seem less, divergence makes it greater. No one can have failed to notice the gross exaggeration of perspective often seen in the stereoscope, when the pictures are so far apart as to make the visual lines parallel or divergent, while the angle between the camera axes, when they were taken, was re-

latively large. But in no case do these conditions cause variations of such magnitude as Brewster's theory of binocular perspective would demand. This is easily illustrated with Wheatstone's reflecting stereoscope. (6) Suppose the stereograph to represent a concave surface with the opening toward the observer, and that the arms of the instrument are properly adjusted. If they are pushed back, so as to make the visual lines divergent, the cavity apparently recedes and deepens; if pulled forward, so as to make them strongly convergent, it seems to approach and grow shallow. The apparent diameter of the image enlarges in the first case and diminishes in the second. Wheatstone notices this last variation in the account which he gave of his invention and its applications, in 1852, in the Bakerian lecture before the Royal Society (6); but, strange to say, the variation which is produced in apparent distance and depth under the same conditions seems to have escaped his notice, and the possibility of using his instrument to test the peculiarities of binocular vision with divergence of visual lines, seems not to have occurred to him. For the refracting stereoscope, however, like Brewster, he constructs a table of apparent distances corresponding to various optic angles, and applicable in using the binocular camera for the purpose of taking slightly dissimilar pictures of the same object. He adds, (7) "when the optic axes are parallel, in strictness there should be no difference between the pictures presented to each eye, and in this case there should be no binocular relief; but I find that an excellent effect is produced, when the axes are nearly parallel, by pictures taken at an inclination of 7° or 8° , and even a difference of 16° or 17° has no decidedly bad effect. There is a peculiarity in such images worthy of remark; although the optic axes are parallel, or nearly so, the image does not appear to be referred to the distance we should, from this circumstance, suppose it to be, but it is perceived to be much nearer." This would not have seemed anomalous to Wheatstone, had he supposed binocular vision possible with divergence of visual lines, and entered into an analysis of the resulting visual phenomena. This analysis will be given in a future paper.

THE WATERS OF PARIS.

IN one of the previous numbers, *La Nature* gives an account of the work of an English observer, Mr. J. Hogg, on the waters of London. But since 1850, Mr. Hassall^a, at the request of the inhabitants of London, examined the degree of purity of the potable waters of that city, and more recently, Professor Farlow, of Boston, make an analogous work at the request of the citizens of that city.^b M. A. Gérardin^c, however, has studied this question with a certain authority, by observing the cryptogamic vegetation in small streams of water which receive the waste products from the factories and manufactories on their banks. M. Gérardin observed that such industry favored the development of certain particular species which were

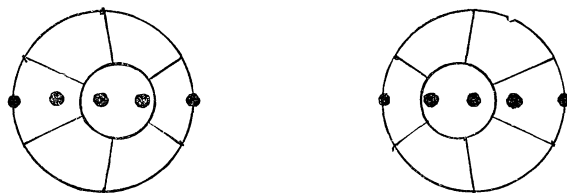


FIG. 3.

(3) Helmholtz, *Optique Physiologique*, pp. 616 and 827.

(4) Ditto, pp. 823, 828.

(5) For description see *Phil. Mag.*, s. 4, vol. III., June, 1852, p. 506.

(6) *Phil. Mag.* s. 4, vol. III., p. 504.

(7) Ditto, p. 514.

(8) *Opt. Phys.*, p. 842.

* Nov. 15th. Since the above was put in type, I have received from Prof. C. F. Himes, of Carlisle, Pa., an article written by him in 1862, in which he mentions his successful attainment of binocular vision by optic divergence, and criticises Brewster's theory of distance in relation to the stereoscope. Though his observation was independent, as my own was also, I find that he was preceded by a German, Burckhardt, in 1860 or 1861. I have already referred to Helmholtz in this connection (*Am. Journal of Science*, Nov. 1881, p. 361) and therefore have claimed no priority in discovering the possibility of this unusual, but still voluntary, employment of the eyes. It is the more remarkable that in our text-books the assumption should be so universal, that convergence of visual lines is a necessity in binocular vision for the determination of the apparent point of sight.

replaced by others in places where a different industry was in operation.

It is in this same order of ideas that the Administrator of Bridges and Roads of the Seine and Oise sent us lately a difficult question to answer. The question was to disinfect a river on the environs of Beaumont, which, during the heat of summer, was poisoned by a cryptogam of the genus *Leptothrix*. This vegetable is an aquatic and filaceous fungi which thrives and grows on the refuse of factories. The only answer to make was the well-known axiom: *sublata causa tollitur effectus*.

M. Neuville, the author of the memoir of which we are treating, is astonished that a work similar to that which he has undertaken, has not yet been done for the waters of Paris, whose sources are different, and which, consequently, do not present an equal degree of purity. Placing himself in a purely utilitarian point of view, he seeks to enlighten the administrator and the public on one of the indispensable sources of nourishment, that is to say the water consumed each day, by making use of his knowledge of cryptogams, and chiefly those of the family of Diatoms, for the study of which he had a predilection.

The complete purity of water is not always on account of the greater or less number of organic matters that it contains; it must be that these matters have a purifying character in themselves, and this condition obtains only when they are living vegetable growths, containing chlorophyll or green matter, having the property of freeing the oxygen which is dissolved in the water, on the one hand, and of absorbing, on the other, the carbonic acid gas which makes the water unfit to drink. Aquatic plants, then, are useful to the water which gives them shelter, yet with the condition that their bodies do not, by their accumulation, counterbalance the salutary effects.

Another cause very often acts to give water unhealthy properties. The lime salts which it holds in solution, and sometimes in great quantity, cause troublesome and sometimes serious diseases. The carbonate, but above all the sulphate, of calcium, makes the waters selenitic, as it is said, and then they become unfit for the cooking of vegetables, do not dissolve soap, and are indigestible. It is possible, however, for water to dissolve soap and nevertheless to cook vegetables; this occurs when in place of sulphate of calcium it contains magnesium.⁴

The waters of the source are often sought after for their limpidity and freshness, which does not always imply that they are really potable; it is even probable that if the waters of our rivers were taken at their source they would not have the qualities which they acquire after a journey of several miles. But when these rivers pass through an important manufacturing city, the injections, the impurities of all sorts which they receive will rapidly change their qualities; stocked, so to speak, in the passage by the city, they are yet able to improve themselves somewhat after a new journey in the country, which permits them to deposit the foreign matters which contaminate them. There are these elementary considerations which should always insist that the waters which supply a city should be taken above and not below the city.

Borrowing from the interesting works of M. Miquel, the savant of the Observatory of Montsouris, whatever they contain of use to his work, M. Neuville, among other things, reproduces the following table of comparison for the use of the reader, and shows what organisms the waters from the source and of different qualities can contain, observed with considerable magnifying power:

PROPORTION OF LOW ORGANISMS CONTAINED IN DIFFERENT WATERS.

	Microbs by hund. cube.
Water of condensation.....	0.2
Rain water.....	35.0
Water of the Vanne.....	62.0
“ “ Seine, in Paris.....	1200.0
Sewer water.....	20000.0

It is indispensable that analyses of this nature should be made rapidly, because in a short time the microbes grow in a great degree, and will no longer give exact figures.

The method which M. Neuville has followed does not consist of chemical analyses of the waters of Paris, which had been done long before by well-known scientists; it is rather a kind of statistics of the foreign matters contained in each of them, and which the use of the microscope reveals.

The waters submitted to his examination are those of the Marne, taken at Saint-Maur and Charenton; of the Seine, at the Port-à-l'Anglais, at the bridge of Austerlitz, taken at Chaillot, Auteuil, and at Saint-Ouen; the waters of the canal of Ourcq, of the Vanne, of the Dhuis, of Arcueil, of the sources of the Nord of Paris, of the artesian wells at Grenelle and Passy, finally that of a well of the left bank of the Seine.

A constant quantity of five litres of water was taken at the middle of the above-mentioned streams, or at the inlet of the waters of the sources; then after a settling of 12 hours, by means of an appropriate siphon, he decanted until it was reduced to 300 grammes. The contents were turned into a graduated gauge and after rest, by the use of a small pipe he gently raised the liquid in order to leave but a deposit of two to three centimetre cubes. It is this deposit which is directly submitted to microscopical observation, after having been put in cellular preparations before being preserved. Observation was made on a determined number of preparations, all sketched in a light room, and the sum of the latter serves to form one of the plates which accompany this article, which contains seventeen. A diagram, or schematic table, indicates the result of chemical analyses and of microscopical observations made for the Seine in its journey through Paris.

The water of the Marne taken at Saint-Maur, is relatively rather pure; yet organic matters are found in great abundance in it; but they are, above all, living matters, and more purifying than corrupting (Fig. 1.) They are a part of the Desmids in the green matter and belong to the genus *Pediastrum* (No. 9) or *Raphidium* (No. 10); or else of filaceous algæ (No. 11) of the genus *Ulothrix*. On the other hand, and much more abundant are the Diatoms with silicious carapace, and, for the most part, gifted with movements of translation very curious to observe. Such are the genera *Sirurella* (No. 1), *Nitzschia* (No. 2 and 3), *Cymatopleura* (No. 4), *Cynedra* (No. 5), *Diatoma* (No. 6), *Pleurosigma* (No. 7), etc., or even Infusoria (No. 13), which make prey of several of these small growths; but, above all, the organic remains. Finally the mineral matters which, in the water of the Marne river, are always more or less muddy, form the small chrySTALLINE groups in the preparation (No. 15). This water is then very good; but on approaching its confluence, that is to say, at Charenton, not only the Diatoms are increased in number, but the Infusoria abound in it as well as detritus, which probably is due to the inhabitants of the Marne at this place.

In the water of the Seine taken at the Port-à-l'Anglais (fig. 2), a very great proportion of organisms is found. This point of the river, intended at one time to furnish Paris with a very potable water, has lost its value on account of the factories and manufactories which are built on it above the city, and the length of the small streams of water which it receives in these places. Desmids are found in it the genus *Closterium* (No. 1), *Scenedesmus*

^a A microscopic exam. of water . . . of London, 1850.

^b Remarks of some Algæ found in the water . . . of Boston, 1877.

^c Rapport sur l'altération, la corruption et l'assainissement des rivières, 1873.

^d Translated from *La Nature*.

(No. 2), *Raphidium* (No. 9), *Tetraspora* (No. 10), and other Algae as *Chlamydococcus* (No. 11) or *Ulothrix*. Infusoria equally (*Chaetonotus* [No. 20], *Brachytous* [No. 23], *Euglena* [No. 12]) and several species of Diatoms already named or a little different. But that which is striking is the already notable quantity of organic remains, fragments of plants (No. 24), mycelium of mushrooms (No. 18), and an eel (No. 17), moving about in the middle of all this multitude, and, in fig. 2, crossing a spicule of Spongille (No. 15).

The water taken at the bridge of Austerlitz is more charged with detritus; the purifying algæ disappear and diatoms are rare. It is infusoria and their bodies which predominate, then finally there are remains of tissues of linen or cotton, of vegetables in decomposition, etc., which the waters of Bercy, of Rapée and Bièvre brought.

If now the water of the pump of Chaillot is examined (fig. 3), the maximum contamination of the Seine is attained. (If this is not, however, the water taken at Saint-Ouen; but at this place the stream has received, as is known, the sewer collector at Asnières, which is a serious cause of infection of the water for a long distance.) The quantity of carbonic acid has already increased, and the oxygen grown less.

In the Chaillot water (fig. 3) there are scarcely any more algæ, here and there remains of conferva (*Cladophora* [No. 14] or some rare specimens of more reduced species (*Pandorina* [No. 1]), *Chlamydococcus* [No. 5], *Sirurella* [No. 2], *Stauroneis* [No. 3], *Epithemia* [No. 4]), yet most often there is only the silicious carapace, void of endochrome, of these last diatoms. On the other hand, the deposit of detritus is dominant in it: muscular fibres, (No. 10), vegetable cellules (No. 11), then myceliums of inferior fungi, and lastly eels (No. 9). Yet there is still more: some microscopic crustaceans appear (*Daphnia pulex* and others [Nos. 7 and 8]), the whole associated with earthy or indeterminable remains.

M. Neuville disputed the opinion of M. Frankland who refuses to admit that rivers purify themselves. He maintains, which seems to be perfectly demonstrated, that after a tranquil journey without receiving other impurities, a river purifies itself, little by little, by deposition, either on the bottom of the bed, or on the banks, of the substances which it held in solution. The harmful matters held in solution are eliminated and they disappear; the carbonic acid becomes exhausted little by little, and the oxygen, on the other hand, returns in proportion.

During the war of 1870-71, the forced stopping on the rivers which habitually received the injections of factories and of industries polluting these streams, had changed their conditions. Thus the Bièvre, tainted from Arcueil to its arrival in the Seine at Paris, had again become limpid, and fish had made a home in it, coming from the parts above Arcueil, although however the bottom of the bed of the Bièvre was at this moment covered by a thick bed of mud nauseating at ordinary times.

The water of the Seine at Saint-Ouen became again more impure than any other part; but, as has been said, this was due to the sewer collector of Asnières. The carbonic acid which, at the bridge of Austerlitz, was represented by 16.2 by hund. cube, reached here the proportion of 65, that is to say the maximum for the waters of Paris. Living creatures here are very rare; but the remains of stuffs: linen, yarn, cotton, animal and vegetable fibres abound here. It is no longer a deposit, it is a real soup. The chlorides, the sulphates, and the sal ammoniacs, as well as sulphuretted hydrogen, are largely represented here. Finally further on, where the Seine passes by St. Denis and receives from it some quantity of refuse, vegetation is no longer found in it, and the bottom of the stream is nothing but a blackish and contaminated mud, as M. Gérardin observed it.

The canal waters of Ourcq have been for a long time the principal source of the supply of Paris. They are

selenitic; but yet M. Neuville does not consider them the worst waters used in the city. A great number of algæ live in them, this being in their favor, and their relative tranquillity is also one of the causes of this notable growth of vegetation. The numerous boats which sail on these waters and the warehouses bordering this canal, where unloading is done, must prove sources of pollution of these waters? Their hydrometric degree is 30° to 31° while the mean of the waters of the Seine is between 17° and 20°, but this does not constitute in the eyes of M. Neuville a plausible reason of inferiority for the waters of Ourcq. It is their stagnation which ought to be the dominant cause of their depreciation.

Figure 4 represents the composition, in organisms, of the waters of the Vanne. It is, according to microscopical observations as well as according to the official reports, the best of the waters of Paris. M. Belgrand says: "comparison was not possible between the excellent waters of the Vanne and those of the Seine and the Ourcq, which, warm in summer, cold in winter, agitated and not transparent in all seasons, are besides tainted more and more by the residue from industrial and human refuse. After a journey of 176 kilometres by means of closed inlets, the waters of the Vanne arrive at the reservoirs of Montsouris and can furnish 100,000 metres cubes of water in 24 hours. Limpid, fresh, exempt from organic matters, it unites all perfections, says M. Neuville, it is water that I wish to see distributed in all Paris."

Several algæ of good quality, such as *Ulothrix* (No. 7), *Melosisa* (No. 2), *Meridion* (No. 1), *Navicula* (No. 3), and *Synedra*, are the respectable inhabitants of these waters; here and there some vegetable growths and earthy remains, and finally some crystals of carbonate or sulphate of calcium (No. 11).

The waters of the Dhuis (fig. 5) only arrive at the reservoirs of Ménilmontant, associated with those of the Surmelin. At their point of junction, those of the Dhuis appear rather pure but nevertheless they are agitated and have need of rest. It is a remarkable thing that the microscope reveals no algæ in them; on the other hand, organisms of another order are met with, some filaments of Mucorinées (No. 1), myceliums (No. 2), and some earthy or organic remains (Nos. 4, 5, 6). According to all appearances, these waters are not sufficiently oxygenated, and a journey a little prolonged in the open air and in the light will make them perfect.

Rivalling with the waters of the Vanne for purity and freshness, the reputation of the waters of Arcueil has been known for a long time (fig. 6); they were so named because they flow through the valley of the Bièvre over an aqueduct at Arcueil. But in truth, they have come from the village of Rungis since the Roman epoch, for these are the waters which supplied the baths called baths of Julius Cæsar or thermæ of Cluny. To the Roman aqueduct, of which several traces remain, succeeded that which can now be seen, built by Desbrosse in 1624, which has to conduct the waters of Rungis to the palace of Luxembourg and in the Saint-Jacques quarter. Advantage is taken of this monument, solidly constructed, to build above it the new aqueduct for the waters of the Vanne, which are conducted to the basin of Montsouris. M. Neuville says "with difficulty can be seen in them, several Vorticelles and Oscillaries (Nos. 1, 5, fig. 6), then several diatoms (*Gomphonema* [No. 3], *Nitzschia* [No. 2]) and lastly some salts of calcium, chrystallized and precipitated from their solution by the loss of a portion of carbonic acid. It is water of good quality, which can be improved by means of successive cascades, and it is unfortunate that we have not more of it.

The sources of the Nord of Paris offer but little interest. Given up to the consumption of the inhabitants of Paris from the end of the twelfth century, they were for a long time the only waters which supplied the fountains of the capital. These, with the waters of Arcueil are the most ancient known. They are furnished by

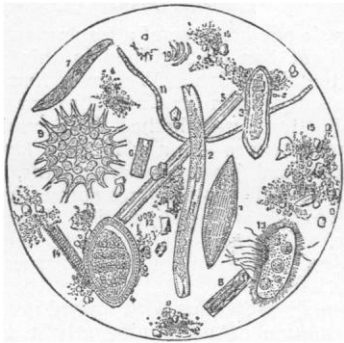


FIG. 1.—Water of the Marne at St. Maur.

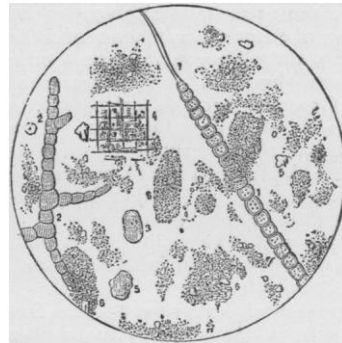


FIG. 5.—Water of the Dhuis.



FIG. 2.—Water of the Seine at Port-à l'Anglais.

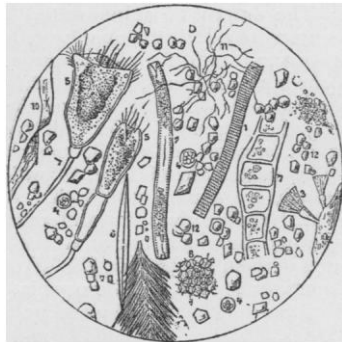


FIG. 6.—Water of Arcueil.



FIG. 3.—Water of the Seine at Chaillot.



FIG. 7.—Water of the Well of Grenelle.

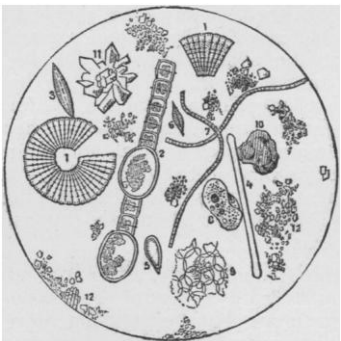


FIG. 4.—Water of the Vanne.

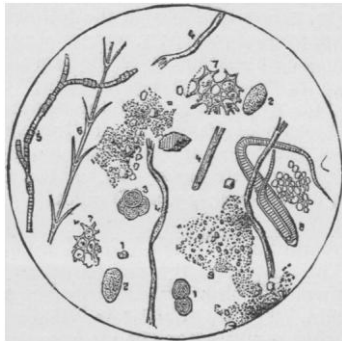


FIG. 8.—Water of the Artesian Well of Passy.

THE WATER SUPPLY OF PARIS.

Saint-Gervais and the heights of Belleville. Their quality leaves much to desire.

"Essentially selenitic, their hydrometric degree reaches enormous proportions: 100 degrees to 150 degrees according as the waters of Saint Gervais and of Belleville are more or less mingled." They contain very little organic matters, some rare algæ and many calcareous crystals.

The well of Grenelle, become celebrated, was commenced in 1833 and only finished in 1841. It was on the occasion of its boring that the relations of the elevation of temperature to the depth of the soil observed by Arago and Walferdin, were stated; that is to say, with every 32 metres the temperature rises one degree.

The water of the well of Grenelle (fig. 7) lacks oxygen which it can gain in the basins of the Pantheon where it is conducted. This water is limpid, indicates at its outlet about 28 degrees, and is very nearly pure from all organism, since it only contains some traces of mycélium of mushrooms (No. 2) and, here and there, several Diatoms (No. 1) probably drawn from the tubes through which it flows. The traces of sulphuretted hydrogen which it contains, impairs a little the quality of this water, but not enough to make it unfit for consumption.

The water of the well of Passy, perforated from 1854 to 1861, can be compared with that of Grenelle (fig. 8). The results which the piercing of this well caused are known; the sale of the water of Grenelle was made considerably less. The carbonate of lime, as well as the bicarbonate of potash, are abundant in both. All things equal, moreover, M. Neuville gives his preference for the waters of Passy rather than for those of Grenelle. Several algæ are found in them (*Calothrix* [No. 8], *Rhizoclonium* [No. 5], *Cosmarium* [No. 1], *Glæocystis* [No. 9]); several encysted infusoria (No. 2), and a few unimportant organic remains.

Lastly, the waters of ordinary wells are potable only when they are not found in a great city. The varied infiltrations, the connection with the soil, and the industries which can contaminate them, are considerations which must be taken into account in deciding the quality of the waters of wells, and which can render them unfit for consumption. They contain at Paris much of the nitrate and sulphate of lime, and they are also very much charged with organic matters in a state of decomposition; but of algæ there is no trace and there are, here and there, several microscopic crustaceans. It is above all in the neighborhood of cemeteries that the waters of wells should not be used except for gross purposes. This advice is upheld by the studies of M. Belgrand, who has observed that, in the environs of Père-Lachaise and of the cemetery of Montparnasse, the waters of wells were stocked, above all during the heat of summer.

Basing his results on microscopical analyses, M. Neuville arranges the waters of Paris in the following order to indicate their degree of purity: 1, waters of the Vanne; 2, of the Marne at Saint-Maur; 3, of the Marne at Charanton; 4, of the Seine at Port-à-l'Anglais; 5, of the canal of Ourcq; 6, of Arcueil; 7, of the sources of the Nord; 8, of the wells of Passy; 9, of Grenelle; 10, of the Dhuis; 11, of the Seine at the bridge of Austerlitz; 12, of a well on the left bank; 13, of the Seine at Saint-Ouen; 14, at Auteuil; 15, at Chaillot.

TIDAL POWER AT BRISTOL.—At a recent meeting of the Town Council of Bristol a motion was brought forward, but not adopted, that "instructions be given to the sanitary authority to cause inquiries to be made into the tidal power of the Avon with a view to its being utilized for working electric lights for the city, the storage of motive power and other purposes, and that scientific aid be employed for the purpose."

THE EVOLUTION OF FLYING ANIMALS.

BY CHARLES MORRIS.

Continued from page 536.

Yet there is one instance of a leaping animal in which a partial flight has been gained in this manner. We allude to the flying-fish. Whatever first induced this creature to spring from the water through the impulse of its swimming motion—whether the pursuit of enemies, or some other cause—at any rate its fore limbs were already developed into wing-like organs, through their use as fins. The flying-fish does not really fly. But an increased spread of its supporting fins, which act as parachutes, would enable it to make longer leaps, and natural selection has undoubtedly produced this extension of the fins.

Land animals present us with several instances of this parachute motion. And significantly it never arises in earth-leaping, but always in tree-leaping animals. Among mammals we find three instances of such a habit, in widely separated families, embracing the Flying Squirrel, the Flying Phalanger, and the Flying Lemur. Among reptiles there is one instance, the Flying Dragon. The three mammalian genera mentioned include a number of species, and an imperfect flight is gained in the same manner in every case. During their so-called flight the limbs are extended almost at right angles to the body, and the skin of the sides has been developed until it is expanded into a broad membrane between these limbs, which, in the case of the Flying Lemur, extends from the nape of the neck to the tail. In their bold leaps from the branches of trees these creatures are partly supported by their membranous wings, so that they descend slowly and easily. Some of them can even slightly vary the direction of their motion, so as to pursue insects.

The flying reptile, the little *Draco Volans*, gains its support in a somewhat different manner. In this case the extended membrane is supported, not upon the limbs but upon the false ribs, which grow out horizontally from their vertebral connection to a considerable distance, giving the animal a wing-like expansion of its sides.

We may readily conjecture the method in which such an organization was gained. The smaller tree dwelling animals are exposed to attacks from foes, the same as all other animals. Or, if carnivorous, they need to pursue their prey. In both these cases the power to make long leaps from branch to branch, or from tree to tree, is so obvious an advantage, that it is not surprising that many animals have become very bold and skillful in this particular. Many of these animals have also the habit of crouching on the branches of trees for concealment, their legs being extended side-wise, and their bodies flattened. This position of the legs in rest would most probably be retained during the leaping motion in which they are not employed. If, then, in any case, the width of the body should be increased, as by a chance extra expansion of the skin of the sides, supported by the outstretched limbs, the animal would be borne up by the air, and could make a longer leap. Such a conformation would aid it in flight or pursuit, and natural selection must operate to retain any such special advantage of form. It certainly seems very probable that the supporting membrane of these creatures was thus developed, and that the Flying Dragon gained its rib expansion through a similar process.

These cases may seem of little importance in an investigation of the origin of the flying power in birds; yet they are, in reality, of considerable importance. They point significantly to the most probable method of flight development, namely, as the result of an original leaping habit, from branch to branch or from tree to tree. Although the above cases are instances of parachute motion only, not of true flight, yet we have strong reason to believe that the earliest flying animals gained their power of flight as a direct extension of the above method.

In the incessant battle for existence among animals the possession of powers of flight are, in certain directions, so specially advantageous, that any accident of conformation, aiding animals in any degree to support themselves in the air, seems very likely to be preserved and to be added to. At present, however, when the field of air is so fully occupied, and there are so many vigorous carnivorous birds constantly seeking for poorly defended food animals, the tendency to develop powers of flight is checked. The aerial motion of the leaping animals mentioned is not such as to greatly expose them to danger from this source. But were their powers of flight increased, so that they could support themselves longer in the air, and move out from the immediate shelter of trees, they would be exposed to attacks from carnivorous birds, and such an imperfect flight must prove a special disadvantage. Their weak flight would expose them to a danger from which they could escape neither by rapidity of motion, nor by a return to the shelter of the forest. Thus the existence of these strong carnivorous birds operates as a decided check on the development of any other form of flight, and it is very unlikely that the leaping creatures mentioned will ever develop a more efficient flight.

There is another illustration of the same principle. The true flying mammals, the bats, perhaps developed their powers of flight at the same geological age as birds did. Thus there was no special hindrance to their evolution. It might seem curious to some, however, that they have failed to gain the same extensive habitat as birds; that they are exclusively crepuscular or nocturnal in their habits, while the birds are almost exclusively diurnal. And yet this difference must have arisen in consequence of a long-continued conflict between bats and birds, in which birds conquered. If we consider that the flying organs of birds are more efficient than those of bats, the whole question is answered. The birds drove the bats back into a field which they did not care to occupy. The fight was for the possession of the air during the day. The birds conquered. The bats were forced to content themselves with nocturnal flight and the imperfect food-supplies which the night yields, while the birds proudly held the dominion of day. It was a case somewhat similar to that which we have already considered, of the supremacy of mammals over reptiles; and the disappearance of the flying Pterosaurs of the far past may possibly have been due, both to the superiority of flying powers and to the more efficient vascular system of birds over flying reptiles.

But there was a period in which the haired animal had not yet succeeded the scaled animal, in which hairs had not been specialized into feathers, and in which the broad fields of air were free to the first occupant, and contained no active carnivora ready to check the development of flight in its incipient stages. Were such the case now, our Flying Squirrels, etc., might gain more efficient powers in this respect, and evolve true flight. We may safely come to this conclusion from the fact that certain lizards gained powers of flight in the early days of bird evolution, and apparently by a direct continuation of the process which we perceive in the Flying Squirrels. The expanded skin between the legs was merely a thin, naked membrane in these lizards. It apparently spread wider and wider, until it extended to the extremities of the toes. But this condition would only produce a more efficient parachute motion. For flight to arise a movement of the fore limbs must be employed, and this may have originated in the effort to keep the body horizontal and prevent its anterior extremity from sinking. Such a movement, with the possession of such a membrane, would yield an imperfect flight. But for the flight to become perfect, in such an animal, the membrane must become still more extended, and the movement of the fore limbs more efficient. This extension was gained by the gradual outgrowth of the fourth finger, to whose tip the

membrane had already extended. By the preservation of favorable variations in this direction, it is very likely that the immensely extended flying finger of the Pterodactyle, the bird-like conformation of its skeleton, and its probably more efficient lung action, were gradually gained; and that it thus developed from an original tree-leaping into a flying reptile.

The advantages of an aerial residence, at that early period when the atmosphere had not yet been preempted by vertebrate inhabitants, were so many and great, that the selective principle must have proved of particular efficiency in this direction. Even a long leap from a solid support infested by many enemies, through an aerial field devoid of enemies, was highly advantageous, and the development of flying powers may have been preceded by the appearance of many animals possessed of a parachute motion. Such animals would leave no geological record, as their motion did not necessarily modify the osseous framework of the body. There are comparatively few of them now, since the advantage to be gained by such powers is greatly reduced. But it is very obvious that any extension of this power, assimilating it to true flight, must have proved far more advantageous. An animal capable of supporting itself in the air, at this early period, was exceptionally free from danger, while its chances to obtain food were greatly increased. The better flyers were, of course, the more secure, and the original partial flight must have rapidly developed into the most perfect flight of which such a membranous wing extension was capable. Not until these flying reptiles began to prey on each other was there any check to their evolution and diversity of formation. The remains of some twenty different species have already been discovered, and this is indicative of hundreds, perhaps thousands, of diverse species of these strangely flying Pterosaurs.

A somewhat similar instance of early and perhaps general possession of the atmospheric field is afforded in the case of insects. Some peculiarity of formation, perhaps the remnant of an original dorsal gill, gave them a structural organ capable of partly aiding them in leaping and of being modified into a membranous wing. But as in vertebrates so in insects, the field of air became in time so fully occupied, and the claimants for its food supply so numerous, that the less vigorous flyers or those adapted to specially terrestrial food, descended to the earth again, and in time lost the power, with the loss of the desire or need, of flight.

Some such fate seems to have overtaken the Pterosaurs. For the possession of the field of air was sharply contested by two other classes of animals, both of which had already stepped beyond the reptilian rank, and become hair-covered and warm-blooded, and one had gained the still more advanced condition of the mammalian organization. The contest between birds, bats, and Pterosaurs, was not alone a battle of flying carnivora, but a struggle for common supplies of food, in which the most vigorous flyer was most likely to win. As a probable consequence of this contest the birds have gained the diurnal possession of the air, the bats have become adapted to nocturnal food supplies, and the Pterosaurs have disappeared. They were probably vanquished in the fight, and gradually resumed terrestrial habits, or died out.

So far as we are aware the evolution of flying mammals was much later than that of birds. But the geological record is so incomplete that bats may have existed at a much earlier date than their discovered remains seem to show. They are found in Eocene deposits, and the bird remains yet found in earlier deposits are very few in number of instances or species. In considering the development of bat flight we are in the same line with those already examined. It is a development of the skin into a flying membrane. But in this case, in addition to the extension of this membrane between the fore and

hind limbs, it is also extended between the fingers of the fore limbs. Possibly in the early flying efforts of bats the fingers were extended in such a manner as to render any accidental growth of skin between them an advantage. Differences in the locomotive habits, and in the foot development, of the progenitors of flying reptiles and flying mammals, may account for this greater extension of the flying membrane in the case of the latter. Naturally such an advantage was seized upon and improved by natural selection. The membrane extended to the tips of the fingers, the fingers themselves grew much longer, and in time the fore limb lost all its powers as a walking organ, but became developed into an efficient flying organ. Bats, by this specialization of their fore limbs, ceased to be quadrupeds, though they never became true bipeds. Sleep and flight constitute the measure of their existence.

Thus the development of all flying vertebrates other than birds pursued the same general course. It began with the extension of the skin of the sides, so as to serve for parachute motion; and ended with an extension of the fingers of the fore limbs, an extension of the membrane to the tips of these elongated fingers, and a flying motion of these limbs. In necessary connection with these were concomitant internal changes, the whole anatomy of the animal becoming adapted to its flying habits.

But in the development of bird flight quite a different mode of evolution appears. Flight is here attained not by a special adaptation of the skin, but of the dermal covering. This covering was probably not the hair in its full modern sense. It was a primitive derivation from the reptilian scale, which secondarily became the avian feather and the mammalian hair. The feather of the bird agrees with the scale of the reptile in being developed in little hillocks upon the skin. The hair of the mammal developed in closed follicles within the skin. There thus has been a specialization in both, with the production of a change in the terminal character of the feather and in the dermal origin of the hair.

The progenitors of birds were either land or tree dwelling reptiles; most probably the latter. We have seen the extreme improbability that any leaping motion from the earth developed into a flight. We have also seen how natural it is for animals to leap from the limbs of trees, and that, in several modern instances, a degree of aerial support has been thus developed. But in such a leaping motion it is highly probable that some animals would make other efforts for support in the air besides the horizontal extension of their limbs. The swimming motion is a very natural one. It is naturally adopted by all land animals which fall into the water, and the webbed feet of swimming birds have been produced by it in the same manner as the webbed fingers of flying bats. Let us now consider some early animal, so far advanced beyond the reptilian ranks as to have become warm blooded, and covered with the primitive form of hair, arboreal in its habits, and accustomed to make long leaps from limb to limb. It is by no means improbable that some such animals would seek to swim in the air. A rapid motion of the fore limbs could not but aid in keeping the body horizontal, and if these limbs were covered with thick hair this must aid in breaking the fall of the animal. Any such habit could have but one result. A thicker hairy covering of the fore limbs, and even of the whole body, would prove an advantage to the animal, and these thickly matted hairs would tend to spread laterally, precisely as we find in the tails of Flying Squirrels and Phalangiers. A still further advantage would be gained were these hairs rough instead of smooth on their edges, so as to cling together, and prevent the air from passing between them.

Such a swimming motion, performed by the fore limbs principally,—the hind limbs being the leaping organs,—and aided by the lateral outgrowth, and the “felting” of rough edged hairs, would, from its inception, be more

than a parachute motion. It would be incipient flight from the first, a swimming in the air. The essential advantages gained by longer and longer leaps must tend to preserve any favorable conditions of the hair, and we can readily conceive the rough edges of the hairs extending into interlocking feathery expansions. In fact it is not difficult to imagine the slow evolution of true feathers in this manner, since every incipient approach to the feather must prove advantageous to the animal in its aerial motion.

But every better adapted movement of the fore limbs must prove similarly advantageous. Not only any variation from hairs towards feathers would be advantageous, but also any variation from a swimming towards a flying movement of the fore limbs. Of course the process must have been a slow one. It was necessarily slow also in the case of the bat and the Pterodactyl. But in all these cases every increment of variation from leaping towards flying was advantageous, so that there was no hindrance to a continual evolution towards full powers of flight.

But the development of the fore limbs into feathered wings unfitted them more and more for walking organs. The slowly developing bird must have trusted more and more to its hind limbs for support. Its arboreal habit developed the toes of these limbs into grasping organs. The original quadruped in time became a true biped, with a foot specially adapted to grasp the rounded surfaces of the limbs of trees, and so changed in position as to fall under the centre of gravity of the body. Hairs became feathers, the bones of the fore limbs aborted in part and became wing bones, and the original tree leaping reptile became a flying bird.

We may close with a very brief further consideration. In the first place it is highly probable that only quite small animals first gained this flying habit. Considerable weight would hinder its development. But after it was once gained there would be no special hindrance to increase in size in the newly evolved species. Yet a very great increase in size would so greatly increase the muscular effort necessary to flight that the larger birds would most likely spend a considerable portion of their time upon the earth. And in many cases the increased weight which is apt to arise from diminution of muscular exercise might render a resumption of the flying habit impossible. Such birds would lose their aerial powers, and become true land bipeds. We may ascribe the land residence, and the aborted wings, of the Ostrich, Cassowary, &c., to some such secondary process of evolution. On the other hand, many virtually land birds have become so by an adaptation to food in the obtaining of which flight was no advantage. Organs not used soon lose their muscular vigor, their size decreases, and gradual abortion takes place, unless adaptation to some new function gives them a special development in this new direction, and checks their tendency to disappear.

II.

STONE IMPLEMENTS IN THE DRIFT.*

BY WATSON C. HOLBROOK.

Many stone implements have been found deeply buried in the clay and gravel of Whiteside county, Illinois. Mindful of the many sources of error, and fully conscious of the many grave and serious questions involved, I have endeavored to examine with care and attention every one of the finds. The first is a black chest spear head about five inches long found incased in a block of granular stalagmite. This specimen was found in a light-blue clay. Above this clay was an alluvial deposit about five feet thick. Some pre-historic man must have left his spear head in a cave or hid it in a fissure of rock. Layer after layer of stalagmite was found. The spear's head

* A. A. A. S., Cincinnati, 1881.

was first covered by this incrustation of limestone, but in the course of time was completely buried in the thin, ribbon-like layers of this stalagmite. Then the floor of the cave was broken up, and the detached piece containing this specimen was carried here by water, or ice, or both, and here it has remained imbedded in this blue clay till all of the alluvium has been deposited. Several arrow-points have been found buried seven or eight feet below the surface of the earth. I have carefully examined two of these finds. They were buried in a tough, compact clay. They were found by workmen while cutting into the hillside and grading the public roads. A small arrow point was found by a friend of mine while digging a well. It was twenty-four feet below the surface of the earth. It is a well-made and beautiful arrow-point, and my friend will not part with his valuable specimen.

FRENCH ACADEMY OF SCIENCES.

August 8, 1881.

MINERALOGY.—M. Klein presents a communication on different solutions of very great density, which can be advantageously utilized in laboratories to separate pulverulent mineral particles from foreign bodies. The salts employed by M. Klein are the tungstoborates of cadmium, nickel and cobalt. The density of the solutions of the last two salts is 3.4; yet M. Klein prefers to them the solution of tungstoborate of cadmium, whose density is only 3.2, but which is quite transparent, while the others are very colored. The tungstoborate of cadmium can, besides, be obtained in crystals; it melts at a temperature of 75°, and becomes a transparent liquid, whose density is 3.6.

PHYSICS.—M. Ancelin described a method of heating intended to replace foot-warmers of water. His system is based on the fact that every body which passes from a liquid to a solid state gives off its latent heat of fusion.

M. Ancelin encloses some acetate of soda in a metallic vase, which is then heated to a temperature of about 80°. Then left to itself, the apparatus cools little by little to about 59°; the acetate of soda then commences to solidify, and gives off its latent heat. While the solidification continues, the vase remains at the same temperature. Boilers heated in this way will remain hot four times as long as by the use of water, about twenty to twenty-two hours.

EXTRACTION OF SULPHUR.—M. Dubreuil, who has devised a new method for extracting the sulphur of Sicily, announces that he has found in the mother waters of the salt marshes of Palermo, charged with chloride of magnesium and boiling at 120°, a suitable substance to separate from the sulphur the earthy bodies which accompany it.

FOR the unities of electric measures there are adopted the fundamental unities—centimetre, gramme, second, and this system is briefly designated by the letters C. G. S. The practical units, the *ohm* and the *volt*, will retain their present definitions; the ohm is a resistance equal to 10⁹ absolute unities (C. G. S.), and the volt is an electromotive force equal to 10⁹ absolute unities (C. G. S.). The practical unit of resistance (ohm) will be represented by a column of mercury of 1 square mm. in section at the temperature of 0° C. An international commission will be charged with ascertaining for practice, by means of new experiments, the height of this column of mercury representing the ohm. The name *ampère* will be given to the current produced by the electromotor force of 1 volt in a circuit whose resistance is 1 ohm. *Coulomb* is the quantity of electricity defined by the condition that in the current of an ampère the section of the conductor is traversed by a coulomb per second. *Farad* is the capacity defined by the condition that a coulomb in a condenser, whose capacity is a farad, establishes a difference of potential of a volt between the armatures.

COMET (*g*) 1881, SWIFT.

At eleven o'clock last evening, Director Lewis Swift, of Warner Observatory, discovered the seventh comet of the year in the Constellation of Cassiopeia in a line between Polaris and the great cluster in Perseus, a trifle nearer Polaris. It is nearly round, faint, has a slight central condensation, but no tail is yet visible. Its right ascension is one hour and fifty minutes, (1 h. 50 m). Declination north seventy-one (71) degrees, and its motion slow westward. Estimated diameter, about four minutes. As the comet of 1812 is anticipated from this quarter, it may be the great Pons Comet. This makes the sixth comet discovered in this country since May 1st, Swift getting the two hundred dollar Warner prize twice. The fifteen hundred dollars given in comet prizes during the past twelve months by Mr. Warner has evidently given an extraordinary impetus to astronomical study in this country. Director Swift, of the Warner Observatory, will visit Egypt, by the generosity of the founder of the Observatory, in December, 1882, to observe the total eclipse of the sun and verify his celebrated discovery of an intra-mercurial planet in 1878, which has been so much disputed by astronomers. C. S. WHITTLERE,

Sec'y. Roch. Astro. Society.

WARNER OBSERVATORY, ROCHESTER,
N. Y., November 17, 1881.

COPYING INK FOR READILY TRANSCRIBING LETTERS WITHOUT A PRESS.

A paper on this subject by Professor Attfield, F.R.S., &c., was read at the last annual Pharmaceutical Conference at York, England. The author stated that for the past thirteen years all letters, reports, &c., that he had written had been transcribed into an ordinary thin-paper copying-book with no more effort than was employed in using a piece of blotting-paper. It had only been necessary to place the page of writing, note size, letter size, or even foolscap, in the letter-book, and use a leaf of the letter-book just as one would use a leaf of blotting-paper. The superfluous ink that would go into blotting-paper went on to the leaf of the letter-book, and, showing through the thin paper as usual, gave, on the other side of the leaf, a perfect transcript of the letter. Any excess of ink on the page, either of the letter or of the copying paper, was removed by placing a sheet of blotting-paper between them and running one's hand firmly over the whole in the ordinary manner.

This ready transcription was accomplished, as would be anticipated, by using ink which dried slowly. Indeed, obviously, the ink must dry sufficiently slowly for the characters at the top of a page of writing to remain wet when the last line was written, while it must dry sufficiently fast to preclude any chance of the copied page being smeared while subsequent pages were being covered. The drying must also be sufficiently rapid to prevent the characters "setting off," as printers term it, from one page on to another after folding.

The author then alluded to some difficulties attending the employment of the ink which had prevented its becoming an article of wholesale trade, but, he said, any chemist and druggist could make it and sell it, giving directions for use to customers. He himself had used it from year's end to year's end without any trouble whatever. It would be particularly useful to professional men and private persons.

The principle of the method of preparation consisted in dissolving a moderately powerful hygroscopic substance in any ordinary ink. After experimenting on all such substances known to him, he gave the preference to glycerin. Reduce, by evaporation, ten volumes of ink to six; then add four volumes of glycerin. Or manufacture some ink of nearly double strength and add to any quantity of it nearly an equal volume of glycerin.

SECONDARY BATTERIES.—J. Rousse.—In order to accumulate electricity for the production of light or motive power, the author has arranged secondary batteries, which differ from those of M. G. Plant. At the negative pole he uses a sheet of palladium, which, during the electrolysis, absorbs more than 900 times its volume of hydrogen. At the positive pole he uses a sheet of lead. The electrolysed liquid is sulphuric acid at 1-10th. This element is very powerful, even when of small dimensions. Another secondary element which has also given good results, is formed at the negative pole of a slender plate of sheet-iron. This plate absorbs more than 200 times its volume of hydrogen when electrolysed in a solution of ammonium sulphate. The positive pole is formed of a plate of lead, pure or covered with a stutium of litharge, or pure oxide, or all these substances mixed. These metallic plates are immersed in a solution containing 50 per cent of ammonium sulphate. Another arrangement is at the negative pole, sheet-iron; at the positive pole a cylinder of ferro-manganese. The electrolysed liquid contains 40 per cent ammonium sulphate.

CONSTITUTION OF THE MILKY WAY.—When the milky way is regarded with an indifferent eye, it seems that its brightness is the same in all parts. But it is quite otherwise when the relative luminous intensity of its different portions is measured. It is then found that the milky way is composed of a series of luminous plates separated from each other by darker portions. Thirty-three of these nodules have been counted, the centre of which is more brilliant than the borders, and it is stated that they are arranged nearly mathematically along a great circle of the celestial sphere.

AN EXPLANATION.

To the Editor of "SCIENCE."

DEAR SIR,—In giving the specific rotatory power in my article "Amylose" in SCIENCE of Oct. 1st this year, I used the expression (a) to designate the specified rotatory power for the *teinte de passage* since that is the usual ray employed. On the other hand I used (aj) to designate the same property for the yellow ray, meaning by the yellow ray the monochromatic sodium flame.

Since, however, it is the usual custom to designate the "rose-purple" transition tint by (aj) as if it were a yellow ray and the sodium ray by (a) D, I desire to make this explanation of the symbols used.

Respectfully,

H. W. WILEY.

LAFAYETTE, IND., Nov. 5, 1881.

OBSERVATIONS AND RESEARCHES ON BLOOD-STAINS.

—D. Vitaci—Attention has been recently called to a reaction discovered by Schœbein—the blue coloration produced by a mixture of oil of turpentine and alcoholic tincture of the resin of guaiacum, on the addition of a little blood or a very dilute solution of hæmoglobin. It is said that this reaction is preferable to any other, not excepting that founded on the formation of crystals of hæmine and on spectroscopic observation, and that none of the substances capable of simulating blood-spots give the same opaque blue color. The author, however, shows that all substances capable of acting as direct or indirect oxidising agents are capable of producing the same reaction.

METEOROLOGICAL REPORT FOR NEW YORK CITY FOR THE WEEK ENDING NOV. 12, 1881.

Latitude 40° 45' 58" N.; Longitude 73° 57' 58" W.; height of instruments above the ground, 53 feet; above the sea, 97 feet; by self-recording instruments.

BAROMETER.							THERMOMETERS.												
NOVEMBER.	MEAN FOR THE DAY.		MAXIMUM.		MINIMUM.		MEAN.		MAXIMUM.				MINIMUM.				MAXI'M		
	Reduced to Freezing.	Time.	Reduced to Freezing.	Time.	Reduced to Freezing.	Time.	Dry Bulb.	Wet Bulb.	Dry Bulb.	Time.	Wet Bulb.	Time.	Dry Bulb.	Time.	Wet Bulb.	Time.		In Sun.	
Sunday, 6--	30.151	30.302	12 p. m.	29.988	0 a. m.	52.3	48.3	60	3 p. m.	52	3 p. m.	46	12 p. m.	43	12 p. m.	112.			
Monday, 7--	30.315	30.400	9 a. m.	30.252	12 p. m.	47.6	46.0	51	5 p. m.	50	12 p. m.	42	7 a. m.	42	7 a. m.	56.			
Tuesday, 8--	30.145	30.252	0 a. m.	30.100	12 p. m.	53.0	57.6	62	4 p. m.	61	4 p. m.	50	0 a. m.	49	0 a. m.	68.			
Wednesday, 9 -	30.008	30.112	12 p. m.	29.910	4 p. m.	62.3	60.0	68	3 p. m.	65	3 p. m.	54	12 p. m.	49	12 p. m.	80.			
Thursday, 10--	30.245	30.296	12 p. m.	30.112	0 a. m.	46.7	43.3	51	2 p. m.	45	2 p. m.	43	12 p. m.	40	12 p. m.	110.			
Friday, 11--	30.319	30.394	9 a. m.	30.222	12 p. m.	42.3	39.0	46	3 p. m.	41	3 p. m.	39	8 a. m.	37	10 a. m.	111.			
Saturday, 12--	29.801	30.222	0 a. m.	29.548	12 p. m.	51.3	50.0	60	8 p. m.	59	8 p. m.	42	2 a. m.	38	2 a. m.	62.			
Mean for the week-----							30.140 inches.		Mean for the week-----							51.5 degrees		49.1 degree s	
Maximum for the week at 9 a. m., Nov. 7th-----							30.400		Maximum for the week at 3 p. m., 9th 68.							at 3 pm 9th, 65.			
Minimum " at 12 p. m., Nov. 12th-----							29.548		Minimum " 8 am, 11th 39.							at 10 am 11th, 37.			
Range-----							.852		Range " " 29.							28.			

WIND.					HYGROMETER.									CLOUDS.			RAIN AND SNOW.				OZONE.
NOVEMBER.	DIRECTION.			VELOCITY IN MILES.	FORCE IN LBS. PER SQR. FEET.		FORCE OF VAPOR.			RELATIVE HUMIDITY.			CLEAR, OVERCAST.			DEPTH OF RAIN AND SNOW IN INCHES.					
	7 a. m.	2 p. m.	9 p. m.		Distance for the Day.	Max.	Time.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	Time of Beginning.	Time of Ending.	Duration, h. m.	Amount of water.	
Sunday, 6.	w. w.	n. w.	n. e.	188	5	1.00 am	.310	.269	.283	92	54	78	0	0	0	---	---	---	---	3	
Monday, 7.	n. e.	e. n. e.	e.	155	2½	5.00 pm	.267	.283	.321	100	78	86	8 cu.	9 cu.	10	7 pm	12 pm	5.00	.04	10	
Tuesday, 8.	n. e.	s. e.	s. s. e.	107	1½	0.15 am	.418	.505	.487	100	94	94	10	10	10	4 am	8 am	4.00	.10	10	
Wednesday, 9.	s. s. e.	w. s. w.	n. w.	154	4½	10.00 pm	.487	.577	.409	94	84	82	10	9 cu.	8 cu.	3 pm	5 pm	2.00	.10	10	
Thursday, 10.	w. n. w.	n. w.	n. w.	273	7½	1.30 am	.275	.220	.218	92	59	75	1 cir.	7 cir. cu.	4 cir. cu.	4 am	11 am	7.00	.13	6	
Friday, 11.	n. n. w.	n. w.	e.	177	3½	0.00 am	.216	.173	.195	90	60	68	3 cir. cu.	1 cir. s.	5 cu.	4 pm	6 pm	2.00	.02	6	
Saturday, 12.	e. s. e.	s. e.	w. s. w.	134	6½	6.00 pm	.231	.348	.487	83	93	94	10	10	10	10½ am	11 pm	12.30	.65	2	

Distance traveled during the week..... 1,188 miles.
Maximum force..... 7¾ lbs.

Total amount of water for the week..... 1.04 inch.
Duration of rain..... 1 day, 8 hours, 30 minutes.

DANIEL DRAPER, Ph. D.

Director Meteorologica Observatory of the Department of Public Parks, New York.